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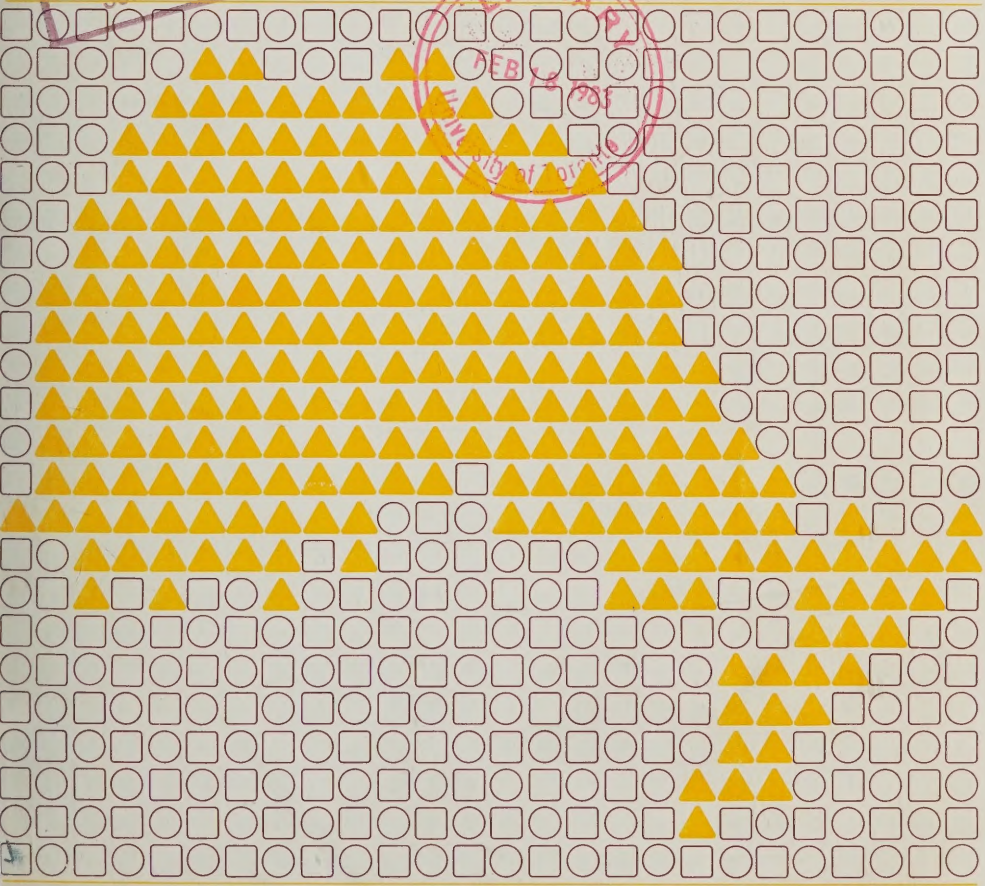
Volume 4, Number 1, January 1983

The Role of Epidemiology in Defining an Occupational Carcinogen

'Bill 17' An Act Respecting Occupational Health and Safety

Arsenic and Medical Surveillance

Overcoming Attitudes Toward Disabled Employees



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Richard A. Fralick, M.D., C.C.F.P., M.H.Sc.

The Role of Epidemiology in Defining an Occupational Carcinogen

Summary

The role of epidemiology in defining an occupational carcinogen is discussed. Two types of observational studies: geographical correlation and prospective are reviewed in some detail. The criteria for causality used by epidemiologists are discussed, with illustrations from the occupational health literature.

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Introduction

Epidemiology is the study of the patterns of disease occurrence in human populations and of the factors that influence these patterns.

Epidemiology has an important role to play in the study of the relative significance of occupational exposure factors in the development of cancer. Various estimates exist of the proportion of cancer attributable to occupational exposure to carcinogens. The proportion may be between one per cent and five per cent.[1,2,3] This has important implications for the prevention of cancer. It is assumed that if the etiology of a cancer can be determined, then primary prevention is possible through either elimination of, or reduced exposure to, the etiologic factors.

There are two types of epidemiologic studies: experimental and observational. The major difference between these two is that in an experimental study the epidemiologist can specify the conditions under which the study is to be conducted, while in an observational study the epidemiologist is not able to control these conditions. The former is typified by a controlled randomized trial and the latter by a prospective study.

The study design is quite important. It should eliminate, as much as possible, confounding variables – variables common to both the exposure characteristic and the disease. Confounding variables may produce an indirect association between the two. The experimental epidemiologic study provides the best control of confounding variables.

In the study of carcinogenesis in human populations one must remember the importance of the long latent period between first identifiable exposure and cancer development. As well, it is often more efficient to study high-risk groups – i.e. a population that differs from the general population because it is composed of either:

1. individuals who show an unusual frequency of a specific cancer, or
2. individuals who are exposed to an unusually high concentration of a suspected carcinogenic stimulus.

In the occupational setting the high-risk groups may be an entire industry, a particular plant or a subset of individuals within that plant.

In this paper I plan to discuss the types of descriptive and analytic observational studies available. Then I will outline in some detail the criteria used to judge the significance of epidemiologic findings.

The Geographic Correlation Study

This is a type of descriptive observational study that relates cancer mortality rates at the county level to environmental and demographic data. The 'outcome' is cancer mortality rates as derived from death certificates. The 'exposure' rates are taken from recent census information as the proportion of the work force engaged in various occupations. The study specifically questions whether an association exists.

An example from the literature should illustrate the important points. Blot and Fraumeni described a survey of lung cancer mortality by county in the United States, 1950–69.[4] They considered US counties as units small enough to be relatively homogeneous for demographic and environmental characteristics, yet large enough to yield stable mortality rates. A multiple regression model was used to relate the lung cancer mortality rate for each county to demographic and occupational indices.

Average annual lung cancer mortality rates per 100,000 population were calculated for the 20-year period 1950–69 for each of the 3,056 counties of the contiguous US. The rates were age-adjusted by the direct method, using the total US population in 1960 as a standard, for each sex and age.

The authors considered white mortality separately from non-white mortality.

White Mortality

The mortality rates for white males and females were related to demographic (geographic region, urbanization), socioeconomic (independent of geographic and urbanization influences) and occupational indices.

1. *Demographic and socioeconomic correlations*
   a) For both sexes, rates increased with urbanization in each geographic region.
   b) Within rural areas, farming communities had substantially lower rates than non-farming counties.

c) Highest rates tended to occur at the lowest educational level.

2. *Industrial correlations*
   a) High-risk industries.
   After adjusting for demographic influences, lung cancer mortality among white males was significantly elevated in counties with four manufacturing industries: paper, chemical, petroleum and transportation.
   b) Low-risk industries.
   Lung cancer mortality was significantly low among white males in counties with the following manufacturing industries: textiles, lumber, furniture and machinery.
   c) Correlations among white females.
   Lung cancer mortality rates were *not* significantly elevated for any group of manufacturing counties. Significantly *low* rates for white females were seen in textile industry counties.

Non-white Mortality

The non-white populations at risk at the county level were often too small to provide meaningful rates for lung cancer mortality. An analysis of their mortality was conducted by considering only the 1,043 US counties with non-white populations of at least 2,000; these counties contained over 95 per cent of the US non-white population.

1. *Demographic* (a comparison of northern vs. southern counties)
   a) Highest rates were seen in urban areas in the north;
   b) in the north, urban areas were higher than rural areas;
   c) there was a north-south difference in comparing rates for white males vs. non-white:
      i) South – white greater than non-white.
      ii) North – (in urban areas) non-white greater than white.

2. *Industrial Correlations* (reported *only* for non-white males)
   a) High-risk industries.
   The same four industries (paper, chemical, petroleum and transportation) showed elevated

lung cancer mortality, although only the chemical industry was statistically significant. Significantly higher rates were seen for counties with primary metals industries.

b) Low-risk industries.
These included textile and furniture.

There are certain limitations to geographic correlation studies. Firstly, confounding variables exist; these may have eluded detection. The degree of confounding may be severe due to the geographic clustering of many risk factors. Secondly, individual risk factors are not identified. In this particular study, there was no county data available on cigarette smoking, an important risk factor for lung cancer. However, as the authors note, other industrial (environmental) factors may be significant risk factors (e.g. dusts, fumes, vapours) even after adjusting for smoking.

Thirdly, exposure and outcome cannot be linked by person. The temporal sequence from cause to effect, as well as the latent period, cannot be taken into account in this type of study. Fourthly, the correlations involve aggregates of individuals, most of whom may *not* be exposed to the occupational agent(s). Thus, the county-wide cancer risk in any of the high-risk industries may be much lower than the actual risk, a dilution effect.

Fifthly, migration may have occurred: out-migration of high-risk individuals from exposed areas and in-migration into exposed areas of less exposed individuals. This also has a dilution effect. Finally, the cause of death as noted on a death certificate may not accurately represent the actual work exposure(s) of the individual.

Nonetheless, this type of study does provide etiologic leads that can be pursued in formal analytic studies, involving hypothesis-testing.

Proportional Mortality Study

This is another type of descriptive observational study. A proportional mortality ratio (PMR) is calculated; this ratio expresses the proportion of observed deaths from a particular cause in the exposed occupational group to the total number of deaths in that group in a given time period.

The death certificates of a group of persons with the same occupation provide the basic data to compute the

PMR – cause of death, age at death and date of death. This type of study is 'quick and dirty': economical of time and resources.

Case-Control Study

This is a type of analytic study; it is also called a Retrospective Study. The analysis involves a comparison of cases with a specific outcome, and controls – those without that outcome. Both groups are compared for their exposure or non-exposure to particular factors. For cancer studies, one would again examine mortality data.

The cases could be: (1) a subgroup within an investigated cohort, (2) hospital-based, or (3) derived from a geographical disease register (e.g. a cancer register). As well, there are several possibilities for the control group: (1) same cohort (as gives rise to the cases), (2) hospital-based, or (3) community controls. In general, the controls may be: (1) deceased and/or living, (2) randomly selected or matched to the cases, and (3) limited to persons with selected causes of death. Case-control studies are usually occupation title-based: complete job histories are obtained and an estimate of the relative risk is computed for all occupation-site combinations.

In a case-control study the risk of cancer from a particular exposure factor is assessed by calculating the *odds ratio*. This is an estimate of the relative risk (discussed later).

Blot and Fraumeni noted in their study that shipbuilding, a subdivision of the transportation industry, and an industry widespread during World War II, may have contributed to part of the lung cancer excess in certain communities.[4] They undertook a case-control study to examine lung cancer mortality after employment in shipyards during World War II.[5] The study revealed a significantly increased risk associated with such employment – RR = 1·6 (a summary relative risk estimate adjusted for smoking, other occupations, age, race and county of residence). As I will discuss later, this indicates a moderate risk.

Prospective Study (syn. Cohort Study)

This is another type of analytic observational study, in which persons who either have a particular characteristic that is suspected of being related to the development of the disease being investigated or have been exposed to a possible etiologic agent are followed for

a period of time to observe who develops and/or dies from that disease.

In the industrial setting the usual type of study undertaken in this category is a historical prospective (or retroprospective cohort) study. A population of occupationally-exposed persons (cohort) is assembled on the basis of *past* records and followed to the *present* to determine its mortality experience. One can examine the mortality experience of the entire cohort or a subgroup of the cohort.

The ability to retrieve and study occupational groups previously exposed to certain chemicals or substances (a historical prospective study) may be advantageous compared to the situation of following an occupational group from now into the future (a cohort study). However, in a historical prospective study it must be emphasized that the effects of the exposure of yesterday, rather than today, are being evaluated.

There are several aspects to the study design; these are particularly important to the epidemiologist. They include:

1. The specific individuals to be included in the cohort or population at risk must be clearly defined. Often one uses a definition relating a number of individuals employed for a given period of time in a plant, job or industry.
2. An entry period into the cohort should be defined.
3. An at-risk period or follow-up period should be clearly specified.
4. An exhaustive review of information that may be available on the type of work, possible exposures, etc. should be undertaken.

Note that selection bias (a bias introduced by the investigator by the selection of cases) is unlikely if (1) previous work records are used (completed at a time when the outcome was not known), and (2) all work records are available (i.e. none have been destroyed).

The information collected is used for three basic purposes:

1. follow-up;
2. evaluation of the possible effects of the work environment; and
3. evaluation of confounding (e.g. previous and subsequent employment, smoking, etc.).

In a prospective study the investigator is interested in the degree of association between various exposures and the outcome(s). The usual measure of association

is the *relative risk* (RR): the risk of disease through exposure relative to the risk of disease through non-exposure. An RR can be calculated from a cohort study while an SMR can be calculated from a historical prospective study. An SMR (Standardized Mortality Ratio) is the ratio of the observed mortality rate in an exposed occupational group *to* the expected mortality rate calculated on the basis of the experience of the general population (or in some cases the total industrial population).

I will have more to say about SMRs and RRs later in this paper.

Epidemiologic Criteria for Causality

I would like to turn to the criteria used by epidemiologists to judge the significance of epidemiologic findings, with illustrations from certain epidemiologic studies of occupational cancer.

1. Statistical Testing

The first step in the analysis of epidemiologic data is the determination of a statistical association between a characteristic and a disease. If a statistical association is demonstrated, the association is significant and not on the basis of chance alone. The type of statistical test will vary according to the study design and the data generated. However, the demonstration of a statistical relationship is only the first step in the epidemiologic analysis. The second step is to ascertain the meaning of the relationship.

2. The Nature of the Association

Is the statistical association artefactual (spurious), indirect or causal? An *artefactual* association may result from biased methods of selecting cases and controls as well as biased methods of recording observations or obtaining information by interview. The presence of a confounding variable or variables common to both the exposure and the disease outcome may produce an *indirect* association between the two.

A *causal* association exists whenever evidence indicates that exposure factors form part of the complex of circumstances that increases the probability of the occurrence of disease and that a diminution of one or more of these factors decreases the frequency of that disease.[6]

The artefactual association can be eliminated if the designs of the epidemiologic studies are determined to be adequate. It is more difficult to evaluate a statisti-

cal relationship to determine whether the association is indirect or causal. There are several ways to evaluate this.

One could perform controlled randomized experiments in human population groups. As noted earlier, this is the best way to control confounding variables. However, experiments can only be done infrequently in human populations.

One could determine the sequence of events from the time of exposure to the etiologic agent through the pathogenetic mechanism to the manifestation of disease to substantiate the causal hypothesis. Information may be available from animal experimentation as well as human natural experiments.

As well, additional epidemiologic evidence may need to be collected. This data can be assessed using several approaches:

a) *Strength of Association*

The strength of the association is measured in terms of the relative risk. Epidemiologists generally believe that strong associations are unlikely to be due to unidentified confounding factors, whereas weak associations could readily be due to confounding. Table 1 provides a guide to the strength of association, from none to infinite.[7]

A mathematical relationship exists between the SMR and the RR. The SMR is calculated by dividing the observed deaths by the expected deaths, multiplied by 100. The RR is calculated by simply dividing the observed death rate by the expected death rate. An SMR of 1,000 is equivalent to an RR of 10·0. However, the RR is a better estimate of the strength of association.

It is important to consider the amount of raw data from which the RR or SMR is calculated. An RR value of 10·0 could arise from an O/E ratio of 3/0·3 or 30/3·0. Obviously, the second ratio indicating higher observed and expected death rates is more

Table 1

A Guide to Strength of Association

Relative Risk		*Strength of Association*
0.9–1.0	1.0–1.2	None
0.7–0.9	1.2–1.5	Weak
0.4–0.7	1.5–3.0	Moderate
0.1–0.4	3.0–10.0	Strong
0.1	10.0	Infinite

Source: Monson R.R.: Occupational Epidemiology, 1980.

suggestive of causality than the first. Thus, in data from a historical prospective study, one usually considers an observed number, an expected number and an SMR value.

If the expected number is very small (e.g. 2), the SMR must be very large (say, 1,000) in order to consider seriously the possibility of a causal association.

As the expected number increases, an SMR value lower than 1,000 may still reflect a causal association. However, even with large expected numbers, an SMR of 150 or less is difficult to interpret. The possibility must be considered that there is some subgroup in the population with a high SMR counterbalanced by a larger subgroup with an SMR or 100 or less.

Because of the 'Healthy Worker Effect', a name given to the observation that employed populations tend to have a lower mortality experience than does the general population, even SMRs less than 100 may be of concern. If the 'all causes' SMR is 70 and the 'all cancer' SMR is 95, one should consider the possibility that some persons developed cancer because of their work. It should be emphasized that greater attention should be paid to an SMR value which is statistically significant.

Table 2 illustrates several points about SMRs and RRs:[8]

Table 2 **Mortality Study of Workers in the Manufacture of Vinyl Chloride and Its Polymers**

Cause of Death	*Observed*	*Expected*	*SMR*	*RR*
All Causes	352	467.28	75	**0.75
All Cancer	79	77.16	110	1.1
Digestive	19	21.67	94	0.94
Liver	7	1.7	412	4.12
Respiratory	25	23.93	112	1.12
Brain	7	2.5	280	2.80
Other	10	9.5	108	1.80

**$p < \cdot 01$

Source: Tabershaw I.R. and Gaffey W.R., J Occup Med 1974.

1. Only the SMR and RR for 'all causes' is statistically significant. The others are not statistically significant, probably because of the small observed and expected values.
2. The low 'all causes' SMR illustrates the healthy worker effect.
3. The SMRs for three cancers: liver, respiratory and brain are moderately elevated. They are not statistically significant, though, probably because of the small values.

From this data one could conclude that an association may exist between vinyl chloride and the three cancers – liver, respiratory and brain.

b) *Consistency*
A consistent association is one that is seen in a variety of settings. In addition, it exists if one observes a decline in disease incidence following a reduction in a particular exposure.

Table 3 presents the results of four studies in mortality of male rubber workers from specific types of cancer. The SMR values have not been included – only one is over 150 (study I: stomach cancer – 187). However, an excess mortality is consistently seen for stomach cancer and leukemia in all four studies. This consistency of the demonstrated association adds strength to the belief of a causal association.

Table 3 **Mortality from Specific Types of Cancer among Four Groups of Male Rubber Workers**

	Study I		*Study II*		*Study III*		*Study IV*	
*Type of Cancer**	*Obs.*	*Exp.*	*Obs.*	*Exp.*	*Obs.*	*Exp.*	*Obs.*	*Exp.*
Stomach	39	20.9	153	122.3	98	93.9	34	27.6
Lung	91	109.3	585	493.5	234	253.1	116	139.8
Bladder	9	12.3	60	38.9	48	39.5	21	18.1
Leukemia	16	12.5	28	23.3	55	43.0	25	18.1

*Slight differences exist in classification of type of cancer.
Source: Monson R.R.: Occupational Epidemiology, 1980.

c) *Specificity*
Is a given exposure factor only associated with a particular outcome and is the outcome associated only with the exposure factor and no other factors? If so, there is specificity of association. In Table 3 entire groups of rubber workers were used to obtain the data. Each group (in each study) consists of persons who have worked in a variety of jobs and who have been exposed to a variety of materials. One should look at specific work areas to see if an association exists.

This is illustrated in Table 4; SMRs for stomach cancer are calculated for selected work areas. (*Note*: The job classifications may vary from one study to another). The SMRs for stomach cancer in these work areas are higher than in the total worker population – i.e. the association of stomach cancer and rubber making is relatively specific.

It should be noted that consistency and specificity argue for causality; their absence, however, does not rule it out.

d) *Dose-Response*
If a factor is of causal importance in a disease, then the risk of developing the disease should be related to the degree of exposure to the factor. The data on the long-term mortality of steelworkers illustrates the dose-response relationship (*, $p < \cdot 05$; **, $p < \cdot 01$).

Several findings are pertinent:

a) For men employed at least five years in specified work areas, SMR for non-white workers in the coke plant was 122 (*).[9]
b) By the same work-duration criteria, the SMRs for selected causes were examined. Again, in the coke plant, SMR for malignant neoplasms was 204 (**).[10]
c) The SMRs were calculated for men employed in the coke plant and subdivisions both in 1953 *and* in years leading up to and including 1953.[11] In both time periods, a statistically significant SMR for malignant neoplasms of the respiratory system was found in the coke plant and in the coke oven, but not in non-oven workers. These SMRs were observed in the non-white, but not the white, workers.
d) The data were further analysed for men employed five or more years at the coke ovens and subdivisions. Table 5 presents this data; note that the SMR increases (and becomes statistically significant) for the three work areas: side oven only, side and

Table 4

Observed and Expected Numbers of Stomach Cancers in Selected Work Areas*

Study	*Work Area*	*Observed*	*Expected*	*SMR*
I	Compounding, Mixing, Milling	12	6.0	200
II	Tyres	65	48.0	135
III	Processing	18	9.9	182
IV	Compounding, Mixing, Milling	9	2.3	391

*Rubber is made in each of these areas.
Source: Monson R.R.: Occupational Epidemiology, 1980.

Table 5

Observed and Expected Deaths and SMRs for Malignant Neoplasms of the Lung, 1953–1961, in Men Employed Five or More Years at Coke Ovens and Subdivisions as of January 1, 1953

Work Area and Race	*Observed Deaths*	*Expected Deaths*	*SMR*
Side Oven Only	6	4.1	146
White	2	1.1	–
Non-white	4	3.0	–
Side and Topside (less than five years full topside)	6	2.1	286**
White	2	1.3	–
Non-white	4	0.8	–
Full-time Topside (five years)	15	1.5	1000**
White	1	0.2	–
Non-white	14	1.3	1077**

– less than five deaths.
* $p < .05$
** $p < .01$

Source: Lloyd: J Occup Med 1971.

topside (less than five years full topside) and full-time topside (five years). In the work area, full-time topside, the high SMR is observed in non-white workers only. Thus there is a progressive increase in the risk of respiratory cancer with increased exposure to the emissions of the coke oven.

3. Biological Plausibility of the Observed Association

A causal hypothesis must be viewed in the light of its biological plausibility. Does the association make biologic sense? As well, the cause (exposure) must precede the effect (cancer). In most epidemiologic studies the decision as to whether exposure or disease occurred first can usually be inferred.

It is important to emphasize the fine distinction between statistical significance and biological significance in epidemiologic studies. The statistical association (resulting in statistical significance) must be present before any relationship can be said to exist. However, only biologically plausible associations can result in biological significance.

Future Trends

There are two future trends in the epidemiology of occupational cancer. One is an exposure-based case-control monitoring system.[12] This is a morbidity study: Newly diagnosed cancer patients are interviewed to obtain their work histories; the work histories are translated into a list of chemicals to which the patient was likely exposed. The list would be compiled through consultation with experts in engineering and chemistry to infer possible chemical exposures. An analysis of the chemical exposure lists of patients with a common tumour could be done to determine whether any chemicals appear in an unusually high proportion of cases. *Note* that the analysis would also be done on job-title so that hazardous occupations could be detected even if the responsible carcinogen has not been identified from the exposure lists.

The other is the role of epidemiology as a guide to cancer control and prevention in industry. Doll and Peto reported the reduction in lung cancer mortality in British physicians when smoking was stopped.[13] If significant exposures can be demonstrated (in industry) and if these exposures can be reduced and/or eliminated, i.e. through primary prevention, it should be possible to demonstrate a significant reduction in cancer mortality.

Résumé

On discute du rôle de l'épidémiologie dans la définition d'un carcinogène professionnel. Deux types d'études d'observations: la prospective et la corrélation géographique sont étudiées en détails. On discute des critères de causalité utilisés par les épidémiologistes, avec des illustrations provenant de la littérature sur la santé au travail.

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M. Roy, M.D., Ph.D.

Arsenic and Medical Surveillance

Summary

The relative worth of assessing arsenic in blood, urine, hair and nails as a measure of occupational exposure is examined. The health effects of arsenic are reviewed and a program for medical surveillance of exposed workers is suggested.

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Ontario workers are exposed to arsenic compounds chiefly in the mining and smelting industries. The exact number of workers exposed is not available, but it may be as many as several thousand.

In performing clinical monitoring of occupationally exposed workers it is important to realize that arsenic is ubiquitous in the earth's crust, and is present as a normal trace element in our food and water. Rarely, some waters may be more heavily contaminated with arsenic that is either naturally-occurring or is there as a result of mining and smelting operations. In Ontario, although there have been sporadic reports of arsenic contamination of wells in the Sudbury region, the arsenic content of Lake Ontario is 0·00091 mg/L, and for Ontario rivers a mean arsenic concentration of 0·00026 mg/L (0·001–0·0014) has been reported. Only four areas in Canada (none in Ontario) had total water arsenic concentrations greater than 0·05 mg/L during the years 1960–76.[1] It has been calculated for 99 per cent of areas sampled in North America that intake and absorption values for arsenic from water should not exceed 0·015-0·020 mg (15–20 μg) daily. From food, an additional average intake of 0·015–0·030 mg (15–30 μg) of arsenic has been calculated from a 1974 FDA survey. It may therefore be estimated that the average total intake from dietary sources for a non-exposed individual is 0·030–0·050 mg (30–50 μg) daily.[2]

Industrial Sources and Uses of Arsenic

At the present time, nearly all arsenic production results as a by-product of copper, lead, zinc, gold or cobalt smelting. Arsenic trioxide sublimes during roasting of the metal ores (10–30 per cent arsenic content as $As_2 0_3$) and is recoverable from the smelter flue dust.[3]

Arsenic trioxide is the starting material for nearly all other arsenic compounds, and its present market distribution is as noted in Table 1.[3]

Table 1

1981 US Market for As_2O_3 (Arsenic Trioxide)

Wood Preservatives	36%
Herbicides	31%
Cotton Dessicants	15%
Molybdenum Flotation	8%
Glass Manufacture	5%
Miscellaneous Uses	5%
	100%

In Ontario, however, agricultural and herbicidal uses of arsenic compounds have declined for most inorganic arsenicals except for the increasing use of ammoniacal copper arsenate (ACA) and chromated copper arsenate (CCA) in wood preservation. Use of organic arsenicals such as disodium methyl arsenate (DSMA), monosodium methyl arsenate (MSMA) and commercial 'arsenic acid' as herbicides and in cotton dessication, while very important in the southern US, is limited in Ontario[3-7]

Miscellaneous uses for various arsenic compounds include high technology applications, lasers, semiconductors and computers, defense applications, heat-seeking missiles, pigment production, animal feed additives, textile printing, tanning, taxidermy, use in antifouling paints, as fungicide in plastic items and to control sludge formation in lubricating oils. In some applications and for some products in the glass industry, for example, no satisfactory substitutes for arsenic compounds have been found.[3]

Absorption, Metabolism and Excretion of Arsenic

There is still inadequate knowledge of the life cycle of arsenic and its absorption, metabolism and excretion. The important route of exposure of workers is by inhalation. It is known that inhalation of airborne arsenic compounds, although dependent on particle size, results in at least 30 per cent of the arsenic being absorbed, and, if subsequent particulate swallowing is considered, probably much more.[8,9] Little is known quantitatively about the rate of uptake into the blood of airborne arsenic actually deposited in the lungs; however, it is known that such uptake of inhaled arsenic is reflected in the worker's urine within 24 hours,[10] and up to 85 per cent of inhaled arsenic actually deposited in the respiratory tract is absorbed within four days.[8] Oral ingestion of arsenic is usually homicidal or suicidal and is rare in the occupational setting. Percutaneous absorption of arsenic may not be

negligible; however, there is little quantitative data on this route of exposure.[2,11,12] Although it is known that arsenic, once absorbed into the blood, is cleared within a few hours and is concentrated in various organs, there is no specific information in the literature on the principal site(s) of metabolism of arsenic. It is known that arsenic inhibits a wide variety of vital enzyme systems, particularly in the glucose active transport system. However, there is little information available concerning the enzymes involved in arsenic's oxidation from arsenite (As III) partially to arsenate (As V) and its subsequent biotransformation to the monomethyl and dimethyl derivatives.[13] Information in the literature regarding the metabolism and excretion of arsenic has been restricted to identifying the structures and amounts of the end products of arsenic metabolism appearing in the urine. Thus, there is limited knowledge of the site and mechanism of the biotransformation of arsenic. In spite of this, it is possible to assess the relative worth of blood, urine, hair and nail analyses in occupationally exposed workers, as outlined below.

Blood

Blood arsenic levels decline rapidly from 15 minutes to two to three hours following cessation of exposure in volunteer subjects tested in the laboratory.[13,14] Within 20 hours arsenic is nearly completely cleared from blood and is concentrated in the liver, kidney, lungs, spleen, bone, muscle and skin tissue. Relatively higher arsenic concentration found in the liver and kidney point to these organs as metabolic sites/excretory organs; however, there is little specific knowledge available concerning these metabolic sites. After metabolism, arsenic is excreted, chiefly in the urine. Attempts to correlate blood arsenic levels with the arsenic level in drinking water have found this relationship to be uniformly poor,[15,16] and there is little information concerning the relationship between blood arsenic and airborne arsenic. Because of the extremely short half-life of blood arsenic and perhaps due to variability in analytical methods, published values for normal blood arsenic have varied through three orders of magnitude (0·001 to 1·0 ppm).[13, 6-22] Thus, normal values of blood arsenic have not been sufficiently defined so as to set an action level for exposed workers, and since blood arsenic has not been correlated with exposure, the use of blood arsenic is limited to serial measurements in acute overdose cases.

Since arsenic levels in blood are not useful for monitoring occupational exposure, the metabolism and excretion pattern of arsenic must be considered for alternatives.

Urine

In 1977, Crecelius, as well as Smith and co-workers, found that inorganic arsenic (both arsenite and arsenate) whether inhaled or ingested is methylated to MAA (methylarsonic acid, approximately 20 per cent), but, in large part, is dimethylated to dimethylarsinic (cacodylic acid, approximately 50 per cent), so that both inorganic and organic arsenic appear in the urine.[9,23]

Of the total arsenic ingested or inhaled, the largest fraction appears in the urine, from 30 per cent to 90 per cent after several days.[14, 23–28] Arsenic excreted in the feces is unabsorbed arsenic and, possibly, absorbed arsenic excreted by the bile, and this fecal arsenic has been found to be five to 10 per cent or less of the total dose.[8,27] Only 0·5 to one per cent of the absorbed dose is excreted in hair and nails.[29] The half-life of absorbed arsenic as measured by the urinary excretion of inorganic arsenic and its metabolites from a single dose of orally ingested arsenic trioxide has been determined by Mappes and, separately, by Crecelius as 1.6 days, and 30 hours, respectively.[23,30] In an experiment simulating chronic arsenic exposure, Mappes ingested 1 mg of arsenic trioxide daily for five days. This resulted in a steady state situation where the daily urinary excretion was 69 to 72 per cent of the daily dose. After the last dose, the half-life of absorbed arsenic as measured by urinary excretion was two days. Pomroy has shown independently that humans go on excreting levels of arsenic elevated above background up to 14 days after exposure to inorganic arsenic.[27] Due to the above kinetics and half-life the most suitable method of monitoring employees exposed to arsenic is to monitor the urine at the end of the work week.[30] Urinary arsenic levels taken at the end of a two-week holiday approximate pre-exposure values for a particular worker.

A normal level of urinary arsenic in a truly non-exposed individual is in the range of 0·030 – 0·050 mg/L (30–50 μg/L).[2,3] When there is exposure to arsenic from the general environment, as within two miles of a smelter, urinary arsenic may range up to 0·300 mg/L. Pinto and co-workers have correlated

levels of total urinary arsenic with airborne arsenic and have found that an airborne arsenic level of 0·05 mg/m^3 corresponds to approximately 0·165 mg/L total arsenic in urine.[31]

Seafood and Urinary Arsenic

A word of caution with respect to seafood ingestion and urinary arsenic is necessary. Fish, including shellfish, contain arsenic as a complex organoarsenical, which is absorbed, but not metabolized, and 60 to 100 per cent of fish arsenic is rapidly excreted intact within one to two days.[31,32] Urinary levels of total arsenic after seafood ingestion may reach 1·0 mg/L or higher within 18 hours after ingestion.[31,33] Since 'fish arsenic' is a toxicologically insignificant form of arsenic, the ingestion of seafood in the previous 48-72 hours will therefore invalidate urinary arsenic as a measure of occupational exposure if the analytical method is not specific for arsenic species.[2,3]

Hair

Arsenic has a high affinity for the sulphydryl (S-H) residues of the sulphur-containing proteins abundant in keratin-containing tissues such as hair, skin and nails,[34] and arsenic accumulates in these ectodermal structures. For occupational exposure measurement of arsenic, hair is attractive since it is a non-invasive procedure employing a matrix which is (1) stable in storage, and (2) provides an extended chronological history (months) of arsenic exposure. When analysis of hair arsenic is performed, however, there are several confounding factors that should be considered. Arsenic may externally contaminate the hair from arsenic contaminated water, arsenic-containing hair products such as shampoos, sweat, and secretion from sebaceous glands, etc.[35-37] The mechanism by which arsenic is deposited in and on hair is unknown, as is the chemical form, but it has been definitely shown by x-ray study of transverse sections of hairs that arsenic is present externally as well as internally.[38]

Although washing procedures for removing arsenic external to the hair have been published, most authors believe that it is impossible to be sure that all external arsenic has been removed.[20,39] Additional factors besides external contamination are variability among different hairs in the head, indefinite period of exposure and lack of an established correlation between airborne arsenic and hair arsenic levels. Although a poor relationship between urine and hair arsenic levels

has been found, in a well-water study there was a moderate correlation (R=0·43) between well-water arsenic and hair arsenic levels.[40] Therefore, while hair arsenic estimations may be useful where arsenic exposure is by the oral route, such as in well-water studies, in the occupational setting they are of limited value even as a screening device on a group basis.

Normal values for hair arsenic may range up to five ppm, but the mean has been found to be approximately two ppm.[41]

Nails

Because of the difficulty in obtaining a sufficient amount of sample, there is less data available in the literature for nail arsenic than for hair arsenic. In the well-water study mentioned earlier, a poor correlation was found between well-water arsenic concentration and nail arsenic levels as compared to hair arsenic (R=0·43 and 0·16, respectively), and nail arsenic concentrations themselves did not differ significantly in the four exposure categories studied.[40] Nail arsenic levels have neither been correlated with airborne arsenic nor with urinary arsenic. The normal values quoted by authoritative sources for nail arsenic levels range up to five ppm.[13,18,27]

Health Effects

Acute arsenic intoxication is usually homicidal or suicidal and is rarely observed in an occupational setting. The estimated fatal dose of arsenic trioxide for humans is in the range of 125 mg.[42] The acute effects of a lethal or near lethal dose are listed below:

Acute

Symptoms	*Signs*
diarrhea, vomiting, nausea, cramps	watery and/or bloody stool
headache, dizziness, weakness, skin—cold and clammy	lowered blood pressure, circulatory failure
inability to walk or move	variable paralysis, muscular incoordination
palpitations	ventricular arrhythmias
shortness of breath	acute inhalation of dust: pulmonary edema

If death is not immediate, jaundice and oliguria or anuria appear after one to three days. Chronic health effects are listed below:

Chronic

Symptoms	*Signs*
skin, nose and mouth irritation, rashes, ulceration	perforated nasal septum, skin thickening and pigmentation*, hyperkeratoses, late cancerous degeneration.
fatigue	normochromic anaemia, neutropenia, relative eosinophilia, thrombocytopenia
burning pains in hands and feet	sensory and motor neurologic deficit

*Mees' lines (transverse white nail striations) may appear weeks after the acute insult.

It is to be noted that skin lesions from arsenic may be transient rashes or permanent arsenical keratoses, the latter now less frequently observed. In either case, such skin lesions indicate that significant systemic absorption of arsenic may be occurring. The occurrence of skin lesions requires a review of personal hygiene and the industrial encironment, and consideration of the frequency of urinary arsenic monitoring as well as air sampling.

There is firm epidemiological evidence, although little animal evidence, that sufficient chronic exposure to airborne arsenic causes lung cancer. Excess lung cancer mortality has been calculated for cohorts of workers employed 25 years or more who have been exposed to airborne arsenic concentrations greater than 0·05 mg/m^3.[10,43,44] There is only suggestive evidence that oral ingestion of arsenic causes angiosarcoma of the liver. The evidence that arsenic causes lymphatic cancer and cirrhosis of the liver is weak.

Medical Surveillance

Based on the above health effects, the following examinations are suggested for workers exposed to arsenic:

Preplacement Examination	*Periodic Examination*
1. Medical history of work exposure and respiratory disease including shortness of breath, cough, sputum production, wheezing and smoking habits.	1. Interim history and change noted.
2. Physical examination including state of skin, nasal examination and examination of superficial lymph nodes.	2. Interim examination and changes noted. If skin lesions present, personal air sampling and urinary arsenic suggested.
3. Assessment of advisability of worker using recommended respirator.	3. Interim assessment.
Special Tests Urinary arsenic (no seafood at least in previous 72 hours). Samples taken after two weeks' holiday should approximate to pre-exposure levels.	*Special Tests* Urinary arsenic (no seafood at least in previous 72 hours). Samples should be taken at end of work week.
Chest X-ray.	Chest X-ray. Sputum cytology (if indicated).
CBC.	CBC. Liver function tests (if indicated). EMG (if indicated).

Conclusion

Water and food exclusive of seafood rarely contribute greater than 0·030–0·050 mg to a worker's daily intake of arsenic. Table 2 lists useful normal and elevated values for arsenic in urine, hair and nails, for ease of reference.

Table 2 **Normal and Elevated Levels of Arsenic in Urine, Hair and Nails**

	Normal	*Elevated*
Urine	≤0·05 mg/L	>0·05 mg/L
Hair	up to 5 ppm	>5 ppm
Nails	up to 5 ppm	>5 ppm

Blood levels of arsenic decline too rapidly to be useful for monitoring workers. Hair arsenic analysis may be useful on a group basis as a screening device for arsenic in the environment, but nail arsenic analysis has not proven useful for environmental screening. If recent seafood intake is excluded, urine is the most appropriate body fluid for the clinical monitoring of workers occupationally exposed to arsenic, since it is a measure of the systemic absorption from recent exposure to arsenic.

Although much remains unknown about arsenic's absorption, metabolism and excretion as well as the full spectrum of its health effects, there already exists sufficient epidemiological evidence to warrant treating arsenic as an occupational carcinogen. Medical surveillance programs of arsenic exposed workers should be developed with this in view.

Résumé

On étudie la valeur relative de l'évaluation de l'arsenic dans le sang, l'urine, les cheveux et les ongles comme moyen de mesurer l'exposition professionnelle. On étudie les effets de l'arsenic sur la santé et on suggère un programme de surveillance médicale pour les travailleurs exposés.

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'BILL 17' An Act Respecting Occupational Health and Safety

Summary

The details and implications of the Quebec provincial government 'Bill 17' are discussed.

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Introduction

Facing unwarranted human and economic costs, multiplicity of laws and regulations, fragmentation of responsibilities, absence of systematic data gathering and inadequacy of health services, the government of Quebec decided to put forward a reform on occupational health and safety. After several years of research and consultation, Bill 17 on occupational health and safety was ratified on December 21, 1979, and has been implemented by stages since then.

Objectives

The primary objective of the Bill is the elimination, at source, of the dangers to workers' health and safety. To this end, the legislators have delegated to workers (unionized or not) and to employers the management and implementation of the Bill.

At the provincial level, the Health and Safety Commission (CSST) and the two parties must plan and propose regulations to the government, determine the budgets and priorities and allocate the resources. At the plant level, they must prepare guidelines on prevention. The Health and Safety Committee of the plant must choose the physician to be in charge of health services, approve the health program, establish training and information programs, and make sure that the hazards of the workplace are eliminated. These functions must be accomplished in collaboration with the government institutions for the health sector, and particularly with the community health network.

Thus, the Bill applies to the two parties concerned, and at all levels.

Rights and Obligations

The Bill on Occupational Health and Safety clearly establishes the fundamental right of the worker to concern himself with working conditions that may

affect his health, safety and physical well-being. In this respect, the rights and obligations of the two parties have been specified.

The Worker

The Bill recognizes the right of the worker to refuse to perform work dangerous to his health and safety. It permits preventive withdrawal when the worker's health may be altered by his working environment. This right also applies to a pregnant worker whose working conditions may be physically dangerous to her unborn child or to herself by reason of her pregnancy.

The benefits related to the work are not altered by the exercise of these rights.

Rights to information and training services on occupational health and safety and to access to curative and preventive health services are also recognized.

Certain obligations have been made clear: The worker must take all necessary measures to ensure the health, safety and physical well-being of himself and his companions. He must co-operate with the Health and Safety Committee in the indentification and elimination of risks from work accidents and occupational diseases.

The Employer

The employer also is entitled to training, information and counselling services in matters of occupational health and safety.

He must take all necessary measures to ensure the health, safety and physical well-being of his workers. To this end, he must see that his establishment has a preventive health and safety program to eliminate, at source, the risks to health, safety and physical well-being of his workers.

The Health and Safety Committee

This committee in the plant is to be the central organization to promote health and safety and to deal with problems related to the quality of working life in the workplace.

In addition to constantly supervising the workplace, the committee must choose the physician to be in charge of health services in the establishment, determine the preventive health and safety program, establish the training and information programs and select

the personal protective equipment. Finally, they must see that registers of work accidents are kept and that the data are analysed.

One may conclude that the Health and Safety Committee is the privileged forum where the two parties shall act in concert on a permanent basis to protect workers' health.

The Health and Safety Commission (CSST)

Bill 17 introduced a major reform of the Workers' Compensation Board (CAT) which, up to now, was responsible for the compensation and rehabilitation of workers affected by accidents or industrial disease. The reform affected two levels.

The Structural Level

The CAT (Commission des accidents du travail) becomes the CSST (Commission de santé et de sécurité du travail). In order to make sure that the parties concerned are really involved in the definition and management of health and safety policies, the board of directors is equally composed of representatives of employers and workers. Seven members are chosen from lists provided by union associations, an equal number from lists provided by employers' associations, and the chairman comes from the public sector.

The Functional Level

The CSST is still responsible for the compensation and the rehabilitation of injured workers and workers with an occupational disease. But it also assumes the full inspection function of establishments which previously had been divided between several ministries. In addition, the prevention of health problems in workplaces and the allocation of resources for plants to implement the provisions provided by Bill 17 are other functions of the CSST. This reform of the CSST provides coherent administrative organization for the application of the occupational health and safety laws and regulations. It aims at promoting a take-over of company health and safety control by the health and safety committee members of the establishment, and the acquisition of the means necessary to protect workers' health and safety.

The Health Services

The prevention of health problems in a particular plant implies that the workers' state of health and the state of the work environment must be known.

Bill 17 proposes that, in each establishment, the health program must aim to measure the risks to health, as well as plan and implement the activities necessary to protect workers' health.

Bill 17 entrusts the Department of Community Health (DSC) with the duty to see that health programs are applied in each establishment. The DSC, affiliated with a medical centre, is responsible for the implementation and development of health programs for the entire population of a given geographical territory.

As a consequence of this Bill, the planning and design of occupational health and safety programs and the organization of the health services in each plant are to be the responsibility of the Quebec public health network.

Résumé

On discute des détails et des implications de la 'Loi 17' du gouvernement provincial du Québec.

Gerald E. Goldberg, Ph.D.

Overcoming Attitudes Toward Disabled Employees

Summary

Negative attitudes towards social or ethnic groups often act as a barrier to communication. Such barriers are of particular concern in the workplace as they can interfere with safety and job performance. This paper reviews the various attitudinal barriers (intellectual, emotional and behavioural) that may result in social isolation of disabled employees by others in the workplace. How such isolation may influence job performance and workplace safety are discussed, and methods for overcoming the various social barriers are presented.

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Distinguishing a Disability from a Handicap

A disability may be defined as a condition of impairment, physical or mental, having an objective aspect that can usually be described by a physician. A handicap includes the limitations that are outside the physical disability, such as barriers imposed by the physical and social environment.[1] For example, while being left-handed is not a disability, it is a handicap when all that is available for work are right-handed scissors or right-handed ladles. Thus, a handicap is the cumulative result of the social and physical obstacles that prevent individuals from reaching their full potential.

Social Rejection of Disabled Workers

It is said that our attitudes or reactions regarding the disabled are their greatest handicap. Attitudes toward the disabled employee can have detrimental effects upon the disabled person's work performance as well as general safety in the workplace.

The basic concern is the general rejection of the disabled worker. This rejection is actually a symptom of a wider based social problem. This is a problem of isolation of the disabled within society, which allows for the development of negative attitudes and misconceptions.

The disabled are often perceived and treated as 'deviates', i.e. separate and different from the larger society. There are a number of factors that have been used to explain this. Certainly, almost by definition, physically disabled persons are physical deviates. However, there are other social and cultural factors that operate to amplify this difference. For example, in larger technological societies, such as Canadian society, there is a tendency to group people with similar disabilities together, often in institutions that offer special care or facilities. As a result of this, disabled persons are frequently isolated from the rest of society. With isolation, further differences can evolve between each disabled group and the general

population. With increasing levels of deviation and isolation, each group may also develop increasing misconceptions about the other groups. These misconceptions may add to isolation and deviation between the groups. When attempts are made to integrate members from one group into another, negative attitudes resulting from isolation, misconceptions and real differences need to be understood and overcome.

Overcoming Barriers to Integration: A Question of Attitudes

The above process of deviance amplification may set the stage for the development of negative attitudes toward the disabled. There are, however, social and psychological factors that may also contribute to this problem. These other contributing factors can best be understood and dealt with in terms of a more precise understanding of attitudes.

Attitudes regarding the disabled may be described as consisting of three component reactions: intellectual, emotional and behavioural. The intellectual component consists of thoughts, ideas, assumptions, evaluations and stereotypes that are elicited as a reaction to disabled persons. The emotional component refers to the emotions or feelings an individual experiences in relation to the disabled (e.g. fear, warmth, guilt, joy, etc.). The behavioural component refers to how individuals physically act toward the disabled (i.e. approach or avoid, welcome or ignore a newly hired disabled worker). Each of these components can operate as a barrier to acceptance of the disabled worker. These barriers, however, can be understood and overcome.

Overcoming Intellectual Barriers

As a result of the isolation between disabled individuals and so-called normal society, one problem that occurs is that 'normals' often take a very simple approach to thinking about disabled individuals. Disabled individuals may be viewed as no more than labels or stereotypes. The disability may be seen as central, or as the key, to a person's behaviour and personality and as largely responsible for the important ramifications in that person's life. This is known as 'spread'.[2] Several studies have shown that people do not hesitate to make judgements regarding a wide range of personality traits based only on the knowledge of a physical disability.[3,4]

There are three devices that can be used to overcome the problem of misconceptions and over-generalization of disabled persons. These devices are actually three ways of developing more precise thoughts about the environment.[5,6]

Indexing. The first device is known as 'indexing'. This is the act of remembering that things that are categorized or labelled as the same are not identical. For example, Politician 'A' is not the same as Politician 'B' or Paraplegic 'A' is not the same as Paraplegic 'B'. In both examples, the personalities and abilities may be very different. Indexing is an important device for remembering that once persons or things are categorized together or come to share the same label, it often takes a conscious effort to recognize the differences or the nuances that make each unique.

Dating. The second device is 'dating'. Dating is remembering that everything is in a constant state of change. Disabilities that once caused a person to be totally dependent on others, may not have that effect today or tomorrow. A disabled person who was known and remembered as helpless may not be helpless today or a disabled person who may experience difficulties when first starting a job may not have these problems when settled into the job or when simple adjustments are completed.

Etcetera. The third device is called the 'etcetera'. This is a reminder that there are infinite complexities in the real world and that no description is ever complete. For example, a quadraplegic, deaf or blind person is also a man or woman who may be an artist, a parent, a taxpayer, a voter, a political activist, a teller of jokes, an excellent worker, etc. The etcetera reminds us that there is always more to learn from, and about, the individual.

Overcoming Emotional Barriers

While intellectual acceptance of more appropriate views regarding the disabled is a start towards improving attitudes, these gains may be short-lived and of little value if attention is not given to the other two components, i.e. feelings and actions. For example, it may be easy to help a person to accept that Friday the thirteenth is just another day; but try to get that person to undergo open heart surgery on that day!

In general, it is more difficult to change people's emotional reactions or feelings toward aspects of their environment than it is to alter their thoughts or actions. This may be particularly true of feelings toward the disabled if, as has been suggested, these negative feelings are a result of a need to perceive the world as a fair and just place and if this need is reinforced by both cultural and parental training.

From childhood, people are usually trained to look for a cause-effect relationship in everything encountered in life. We are often taught, and usually like to believe, that positive effects are derived from positive causes, and negative effects, from negative causes. This sense of justice is based upon the supposition that reward and virtue are linked together, as are punishment and evil. Thus, it is often felt that physical disabilities must be a result of a negative cause. In other words, disabilities and illnesses are, to some extent, often felt to be a form of punishment for misbehaviour. There are a number of studies that demonstrate this misconception. When subjects where shown pictures of individuals with facial anomalies they were perceived as evil.[7] When subjects were shown pictures of victims of car accidents, the more severe the apparent injuries, the more the victims were rated as responsible for their fates.

The need to see the world as a just place likely stems from a basic need to see the world as orderly; orderly enough to accept that one will be rewarded for virtuous acts and punished for evil ones. Early cultural and social training likely plays a central role in maintaining and reinforcing these beliefs, if not in originating them. Children's stories often portray evil characters as deformed. In the Old Testament, illness was considered a punishment for evil. The Bible mentions twelve blemishes that disqualify a man from being a priest; these include 'a blind man or a lame, or he that hath a flat nose.'[8]

Parents also may reinforce the idea of illness as punishment by using illness as a threat, e.g. 'If you stay up late, you'll get sick.' or 'If you go without your rubbers, you'll catch a cold.' Even though this type of cause-effect relationship does have a basis in reality, it also teaches that sickness is a punishment for misbehaviour.

Individuals are not likely to be conscious of their need to view the world as a just and orderly place. Neither may they be conscious of the social training that helps to develop this need. Since this need and

social training are not usually conscious, they are most likely to be expressed as negative emotion or 'gut reactions' to the disabled, rather than as intellectualized evaluations of their personalities.

Another factor that contributes to negative feelings toward the disabled results from the lack of exposure and social interaction between 'normals' and disabled individuals. When the two are suddenly forced to interact there are bound to be feelings of anxiety based upon uncertainties regarding what is appropriate behaviour.

The 'normal' may have anxieties about interacting with a disabled employee. These anxieties may stem from previously held negative attitudes toward the disabled as well as from the uncertainties of appropriate behaviour. Experiencing such anxiety may give rise to feelings of embarrassment, guilt, anger, aggression, etc. These emotional reactions then may be linked to the source of the original anxiety, i.e. the exposure to, or interaction with, the disabled individual.

A first step toward improving people's feelings about the disabled is making them aware of their possible negative feelings and helping them to accept them as real and understandable in terms of the personal and social factors involved. Toward this end, it may be useful to refer to all or some of the factors suggested within this paper: The need to view the world as just; social and cultural training; anxiety and uncertainty regarding personal interaction; and emotional reactions to one's own anxieties regarding the disabled.

A second step in changing negative feelings would be to provide some form of continued exposure to disabled individuals. A series of concrete experiences with the disabled can help to provide a basis for the re-establisment of new feelings. While exposure alone may have positive results, preparation in terms of helping both 'normals' and disabled individuals deal with their emotions will help ensure success.

It should be remembered that changing people's negative feelings toward disabled individuals usually requires time. Time to readjust personal feelings is particularly important if these emotional reactions are based upon early cultural and social training and/or a personal need to view the world as just.

Overcoming Behavioural Barriers

A central problem with the behavioural component of co-worker's attitudes (i.e. how they act toward the disabled employee), may be one of rejection or isolation. This rejection and isolation may be overcome by creating situations on the job or in the workplace in which there is some degree of regular social interaction between disabled individuals and their co-workers. It must be expected, however, that overcoming rejection and isolation will occur in stages.

Davis[9] describes three stages through which such acceptance of disabled individuals develops. At first, there is a 'fictional acceptance stage' in which there is a superficial, strained and limited type of interaction. During this stage, interactions tend to be brief and about impersonal topics (e.g. talking about the weather). This 'fictional acceptance' is then followed by a 'breaking through stage'. In this stage, there is a movement to somewhat more personal topics and a redefining of ideas about one's self and the disabled individual. Finally, there is a 'normalization of relationship stage' in which there is a stabilization of the relationship and the disability is treated only as one aspect of the individual. With interaction, the 'normal' may literally forget the disability of the other, perhaps even leaving a paraplegic behind when running to make a green light. On the other hand, the disability may, at times, become part of the personal humour and general interactions between the individuals. For example, this author cannot tell left from right very quickly, however, I always remember in which hand I hold my milk, coffee or beer (my left). I also remember in which hand I hold my sandwich (my right). My wife knows that when I drive, telling me to go left or right is useless, frustrating and dangerous; but we both can chuckle and feel confident that there is no problem if she tells me to turn 'milk' or 'sandwich'.

Consistency in Thought, Feeling and Action

The three components of attitudes (intellectual, emotional and behavioural) are not usually independent of each other in that they tend to be consistent or in harmony with each other. There is a good deal of evidence to suggest that individuals become uncomfortable when they experience inconsistency between their thoughts, feelings and actions (i.e. the respective intellectual, emotional and behavioural components of attitudes) and so will seek out a means of regaining

consistency. As a result, efforts to alter one or two of the components of attitudes may be thwarted by the remaining component or components. On the other hand, a change in any one of the components, in either a positive or negative direction, will place pressure upon the other components to change in a similar direction.

Occupational Safety and Interpersonal Attitudes

The problem of negative attitudes toward groups or individuals may have far reaching effects. Such attitudes can influence both the quality of the involved person's work and the general safety of the workplace in several ways.

Expectancy Effect

If employers and co-workers expect poor and unsafe performance from certain individuals, it is likely that, with time, these employees will conform to the lesser standards expected of them. This is called the 'expectancy effect'. Conforming to the expectancies of others is a well-known phenomenon in the social sciences. For example, it has been demonstrated that performance in intelligence tests can be greatly influenced by the expectancy of others. If adults expect children to perform poorly in such tests, this will often result in lowered performance scores.[10]

Disabled as 'Deviate'

Some employees may find themselves in the role of 'deviate' in that co-workers may either be unwilling to interact with them or interact in only a strained, limited or superficial manner. Employees may find themselves in this 'deviate' role as a result of any number of social, ethnic or personal characteristics. Disabled individuals often are faced with this situation.[9]

The potential impact of work group relationships upon accidents has been demonstrated. One study that investigated this relationship used a technique for exploring social interactions within a group whereby each member of the group privately indicated which of the other workers were his or her friends.[11] It was found that men who were least popular had the highest accident rates. One reason for this may be that an

unpopular individual is not kept fully informed by co-workers about changes in dangerous conditions. Physical disabilities of workers may contribute to this problem, especially if the employee is perceived as less attractive or less similar to co-workers in either background or personal problems as a result of the disability. There is evidence that people are more likely to offer help to those they perceive as more physically attractive or more similar to themselves in background or fate.[13,14]

Impact of Rejection

A third threat to safety in the workplace is derived from the possible preoccupation with social rejection and/or the stress resulting from social isolation. Such preoccupation could interfere with the recognition of danger, alter the degree of on and off-the-job risk taking or even reduce an individual's physical ability to avoid a dangerous situation.[11]

Conclusions

Negative attitudes toward individuals, social, or ethnic groups often act as a barrier to communication. Such barriers are of particular concern in the workplace as they may interfere with safety and job performance. For example, in the case of disabled individuals, negative attitudes can result in the isolation of the disabled within society and misconceptions about them. Employers' and co-workers' misconceptions and rejection of disabled workers may have a number of detrimental effects upon their work performance as well as on general safety in the workplace. Performance and safety standards will both suffer if less is expected of a worker or if workers are rejected and socially isolated.

A wide range of personal, social and cultural factors may lead to negative attitudes toward various individuals or social groups. The negative attitudes, however, may be overcome within the workplace, even though they may represent a broader social problem of isolation and rejection. The first step in overcoming this problem would be to help employers and co-workers understand their own reactions or attitudes (intellectual, emotional and behavioural) toward disliked individuals or groups. After an awareness of the causes for negative attitudes have been established,

exposure to, and social contact with, socially isolated individuals should provide all parties with the opportunity to form a new attitude of acceptance. This paper describes the process of attitude change as it relates to acceptance of the disabled within the workplace.

Résumé

Les attitudes négatives envers les groupes sociaux ou ethniques sont souvent des obstacles à la communication. Ces obstacles sont particulièrement importants au travail où ils peuvent avoir des effets sur la sécurité et le rendement au travail. Ce document étudie les divers obstacles résultant des attitudes (intellectuelles, émotives et de comportement) qui peuvent provoquer l'isolement social des employés handicapés par les autres travailleurs. On étudie comment cet isolement peut influencer le rendement et la sécurité au travail et on présente des méthodes pour surmonter les divers obstacles sociaux.

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Book Review

Cancer of Ontario 1981
Ed. J. O. Godden

Published by and available from
The Ontario Cancer Treatment and Research Foundation,
7 Overlea Blvd.,
Toronto, Ontario
M4H 1A8.

274 pp.

The book gives an annual review of the activities of the Ontario Cancer Treatment and Research Foundation. It informs the physician working in the field of the special services provided by the foundation (pages 191–7) and of the regional treatment centres and their activities (pages 202–24).

The special services of the foundation provide special chemotherapeutic agents to cancer patients – residents of Ontario – who are under the care of their physicians at home. They also administer and monitor a program for carcino-embryonic antigen for confirmed cases of cancer, a steroid-receptor assay program for confirmed cases of breast cancer and a diagnostic biopsy service.

On pages 4 and 5 new projects approved for support in 1981 are listed.

Three papers (in full or in abstracts) presented at meetings in Ontario are to be found on pages 15–23. These papers are also of interest to the non-oncologist. The first paper (Dr. G.F. Whitmore – Radiation Hypoxic – Cell Sensitizers) explains the rationale of drugs to decrease the radiation resistance of hypoxic tumour cells. These drugs may have a place as adjuvants for radiation therapy. However, their major limitation is their pronounced neurotoxicity (Misonidasole, Nitrofurazone, Flagyl, NDPP). Dr. M.A. Bagshaw (page 21 – External Beam Radiation Therapy in Carcinoma of the Prostate) discusses the value of radiation therapy for patients with lymph-node metastases and negative bone scans. Dr. I.R. Hart in Some Advances in Metastatic Research (page 23) states that the presence of tumour cells in the circulation does not necessarily constitute a metastasis as most of the cells released into the blood stream are rapidly eliminated. He quotes that only one per cent of an inoculum of radiolabelled murine B16 melanoma cells survived to form secondary growth. We do not yet fully understand the mechanisms that control tumour spread.

Also, the papers presented at the 8th Clinical Cancer Research Conference held at Lake Couchiching, Ontario, in 1981 will be of interest to the physician working in occupational medicine.

Epidemiology and Statistics (pages 71–99) gives statistical details of cancer mortality and morbidity in the province of Ontario. Male cancer deaths have been steadily increasing over the years; however, non-lung cancer death rates have shown a decline in the latest 32-year period. A similar trend can be also observed in the female cancer deaths. I missed a table giving the incidence of occupational cancers.

In the remainder of the book, various projects in research of malignancy are mentioned.

J.G. Budlovsky

Publications Available from the Government Book Store

Publications under the Regulation Act vol. 112–39	
Revised Regulations of Ontario, 1980 Regulation 692/80 Industrial Establishments	$2.00
Revised Regulations of Ontario, 1980 Regulation 691/80 Construction Projects	$2.00
Revised Regulations of Ontario, 1980 Regulation 694/80 Mines and Mining Plants	$2.00
Regulation respecting Lead – made under the Occupational Health and Safety Act Ontario Regulation 536/81	$1.00
Regulation respecting Mercury – made under the Occupational Health and Safety Act Ontario Regulation 141/82	$1.00
Regulation respecting Vinyl Chloride – made under the Occupational Health and Safety Act Ontario Regulation 516/82	$1.00
Regulation respecting Coke Oven Emissions – made under the Occupational Health and Safety Act Ontario Regulation 517/82	$1.00
Regulation respecting Asbestos – made under the Occupational Health and Safety Act Ontario Regulation 570/82	$1.00
An Occupational Health Nurse's Guide to the Preparation of a Policy and Procedure Manual	$2.00
A Guide to The Occupational Health and Safety Act, 1978	$1.00

News and Notes

A new training and information program designed to increase safety awareness throughout Ontario's mining community has been announced by Labour Minister Russell H. Ramsay, and James Gordon, MPP for Sudbury.

The $270,000 program, to be developed and produced in the Sudbury area, will consist of 30 training 'modules' dealing with mining regulations and ministry objectives. The program is expected to reach close to 60,000 mining industry people.

The Mining Accident Prevention Association of Ontario (MAPAO), an organization of mining employers whose main function is the promotion of safety in the mining industry, will provide $90,000 for the program. The Ministry of Labour will provide $180,000.

'The whole of the northern mining community will benefit from this very practical initiative,' Mr. Gordon said. 'The portability of the modules and the self-teaching approach will allow us to reach virtually every worker in every mining establishment in Northern Ontario.'

The modules, which will consist of slide-tape shows and printed manuals, will be produced through the co-operation of the Ministry of Labour, MAPAO and organized labour. They will provide inspectors, supervisors and workers with training in safe work practices, hazard identification and unsafe condition indentification in the workplace. They will be keyed to Mining Regulations under the Occupational Health and Safety Act and the Mining Health and Safety Branch's objectives regarding Mining, Working Environment and Electrical-Mechanical inspection.

The material, to be produced by Pacsel International of Lively, Ontario, will utilize visuals photographed in Sudbury, Elliot Lake and Timmins. The first modules are expected to be available in 1983.

'The co-operative effort by the ministry and MAPAO in funding, and the tripartite approach to program input will serve the whole mining community,' said Ernie Issacs, executive director of MAPAO.

'When implemented, this project will create a ripple effect and the message of safe work practices will reach inspectors, union health and safety representatives and industry supervisors. I am extremely pleased that all parties concerned displayed such great enthusiasm and commitment to this project,' said Labour Minister Ramsay. 'Co-operation of this type will assure us of high quality, practical programs which will benefit everyone involved in Ontario's mining industry.'

The production of mining safety training modules is a result of recommendations for increased inspector training contained in the Ham Commission on Health and Safety of Workers in Mines (1974), the Federal-Provincial Inquiry Commission into Mines and Mining Plants in Ontario (1980), and 1981 Select Commission on Ontario Hydro.

Academy of Medicine, Toronto

Thursday, February 3, 1983. – Academy of Medicine, Toronto – 5:30 p.m. Academy Librarian will give a five to 10-minute presentation on the Library facilities, and Paul Deitrich, LL.B. and Dr. Peter Pelmear will discuss the Designated Substances and the role of the Occupational Physician.

Wednesday, March 2, 1983. – Visit to Ministry of Labour Laboratory, 101 Resources Road, Weston, Ontario – 2:30 p.m. to 5:00 p.m. Tour of the facilities by Dr. Mark Nazar.

Thursday, May 5, 1983. – Academy of Medicine, Toronto – 5:30 p.m. Meeting on the Psychotic and Employment – Medical Legal Aspects by Lawyer Aubrey Golden, Labour Lawyer, with presentations by Dr. E. Kaegi and Dr. J. Nethercott.

Thursday, June 2, 1983. – Academy of Medicine, Toronto – 6:30 p.m. Cocktails: 7:00 p.m. Dinner: 8:00 p.m. Meeting on the Relationship of Anthropology to Occupational Health, by Dr. William Swinton, Past Curator of the British Museum.

Symposium on Chlorinated Dioxins and Dibenzofurans in the Total Environment II

Sponsored jointly by
The Division of Environmental Chemistry,
The Analytical Chemistry Division and
The Division of Chemical Health and Safety,
American Chemical Society

Because of the growing concern for the exposure to chlorinated dioxins and dibenzofurans in the total environment – occupational and ecological – two symposia were planned in conjunction with the national meetings of the American Chemical Society. The first symposium was held with great success at the September 1982 meeting in Kansas City, Missouri. The second symposium will be held August 28 – September 2, 1983, in Washington, D.C.

The primary purpose of both symposia is to provide state-of-the-art technology and information on chlorinated dioxins and dibenzofurans. Efforts will be made to identify the facts and to indicate recommendations for the future. The technical program will encompass the specific areas of formation and occurrence, sampling and analysis, human toxicology, general exposure considerations and special control and decontamination measures. Both invited and contributed papers will be solicited. Overview as well as original research papers are planned.

Interested persons are requested to submit a 200-word abstract and a two to four-page extended abstract to Dr. Lawrence H. Keith by April 1, 1983 for this meeting. Instructions for preparation of the division's extended abstract and the ACS abstract forms can be obtained from any of the symposium co-ordinators listed below.

For further information please contact:

Dr. Lawrence H. Keith,
Division of Environmental Chemistry,
Radian Corporation,
P.O. Box 9948,
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(512) 454-4797

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(513) 684-4217

Dr. Christoffer Rappe,
Chairman,
Department of Organic Chemistry,
University of Umea,
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46/90/165266

VI International Symposium on Occupational Health in the Production of Artificial Organic Fibres

Permanent Commission and International Association on Occupational Health

Scientific Committee for Occupational Health in the Production of Artificial Organic Fibres

Mannheim/FRG
September 13–17, 1983

First Announcement

Topics

1) Experimental research on acrylonitrile, dimethylformamide, CS_2, H_2S and other agents liberated during the production of artificial organic fibres
2) Epidemiological studies of exposed workers
3) Toxicological problems in the production of organic fibres other than viscose rayon
4) Occupational health practice and industrial hygiene

Papers may also be presented on all other problems arising from the production of artificial organic fibres.

The Scientific Program will include a visit to a plant producing acrylonitrile and dimethylformamide.

Language

The official language will be English.

All presentations should be given in English since no simultaneous translation will be provided.

Coming Events

March 22–25, 1983	Ergonomics Society Annual Conference, Churchill College, Cambridge, U.K.
March 24–25, 1983	Society of Occupational Medicine Spring Meeting, London, England.
May 8–13, 1983	10th World Congress on the Prevention of Occupational Accidents and Diseases, Ottawa, Ontario, Canada.
May 16–18, 1983	Cancer in the Workplace, International Conference. The University of British Columbia, Vancouver, British Columbia, Canada.
July, 1983	Society of Occupational Medicine Annual Provincial Meeting, Portsmouth, U.K.
July 12–14, 1983	Ultrasonics International '83, Dalhousie University, Halifax, Nova Scotia, Canada.
July 19–22, 1983	Second International Conference on the Clinical Chemistry and Chemical Toxicology of Metals, Montreal, Quebec, Canada.
August 28– September 2, 1983	American Chemical Society Symposium on Chlorinated Diseases and Dibenzofurans in the Total Environment, II.
September 5–10, 1983	XXI International Congress on Occupational Health, Dublin, Ireland.
September 10–14, 1983	9th International Congress on Agricultural Medicine, Christchurch, New Zealand. Details from John Stoke, Deputy Director (Occupational Health), Division of Public Health, Department of Health, Macarthy Trust Building, Lambton Quay, Wellington, New Zealand.
September 13–17, 1983	VI International Symposium on Occupational Health in the Production of Artificial Organic Fibres, Permanent Commission and International Association on Occupational Health, Mannheim, Federal Republic of Germany.
September 20–23, 1983	VIth International Pneumoconiosis Conference, Ministry of Labour and Social Affairs of the Federal Republic of Germany, Bochum, Federal Republic of Germany.

Ontario Ministry of Labour

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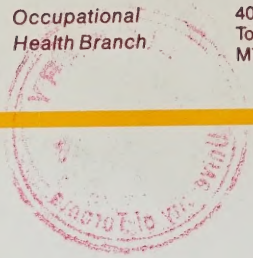

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